NORTHERN ARIZONA UNIVERSITY

College of Engineering, Informatics, and Applied Sciences

SCHOOL of INFORMATICS, COMPUTING, and CYBER SYSTEMS

Course Syllabus

CS 486 – Senior Capstone Design		Fall 2023
Class #: 1147 **Credits:** 4 credits Lecture + 0 credit lab	Pre-reqs: BSCS majors: CS 315, CS 396, and CS 476 ACS majors: CS 212, CS 345, and CS 476 All with grades of C or better in each	**Co-Reqs:** N/A
Section#: 1	**Co-convened/Cross-listed with:** N/A	**Mode:** in-person, face-to-face

Academic Catalog Description: Implementation of sponsor-accepted proposal culminating in an oral presentation, product demonstration, and formal report. Topics include project management, software architecture and design, software implementation, testing, and documentation. Must be taken in the semester of graduation. Letter grade only. Course fee required.

Course Purpose: This course is the second part of the two-semester CS Capstone sequence. In this course, we continue with work on the projects initiated in CS476. Building on the strong requirements, initial design ideas, and technical demos you've developed by the end of fall term, the focus is on completing the implementation of the projects, including: detailed software architecture and design, early development of a functional prototype, functional and end-user testing, and iterative refinements. The course finishes with the UGRADS Capstone Design Conference, where all NAU Engineering Capstone teams will formally present and demonstrate their projects.

Upon successful completion of this course, students will have gained basic competencies in small team project management, will have solid skill in effective written and oral communication of technical material, will have direct experience with the implementation and testing phases of a realistic product design cycle, and will have a gained the skills and confidence to transition from a classroom-oriented academic environment to and outcomes-oriented professional environment.

ABET Program Learning Outcomes supported

Outcomes	Achievement Assessments
Outcome 2: An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs. **Outcome 5:** An ability to function effectively on teams to accomplish a common goal **Outcome 3:** An ability to communicate effectively with a range of audiences **Outcome 6:** An ability to use current techniques, skills, and tools necessary for computing practice.	Team and individual project deliverables Weekly meetings, task reports, and mentor's meeting notes Design Review Presentations Evaluation of performance at Capstone Conference events Confidential peer evaluations Sponsor evaluations of team and individual members Team mentor evaluations Team reflection document

Detailed Information for this offering

Time and Location:

Section 1: 9:10am - 11:40am, Engineering (Building #69), Room 101

Some meetings as a full class group will occur, with prior notice provided; weekly team meetings with team mentors will occur to review progress, at a time negotiated. Class time block is used for all-hands Design Review presentations and other full class activities up to three to five times a semester.

Course Website: CS486: CS Capstone Design (nau.edu)

Readings and Materials:

Course Textbook: There are no required textbooks for this course. The following are highly recommended texts:

- Code Complete: A Practical Handbook of Software Construction, Second Edition, by Steve McConnell
- The Mythical Man-Month: Essays on Software Engineering, Anniversary Edition, by Frederick P. Brooks
- Difficult Conversations: How To Discuss What Matters Most, by D. Stone, B. Patton, and S. Heen

Instructor's Name: **Dr. Michael Leverington (course facilitator) + CS team mentors for each**

Office Building/Room Number: **69-243 (EGR)**

Email: Use BBLearn email as shown on the course page

Instructor Availability:

Office Hours:	**See BBLearn for up to date office hours**
Other:	• We sometimes change office hours by class vote during the term to accommodate your schedules better. Check BBLearn for latest! • Although you should try hard to make it to scheduled office hours, we are also available at other times by appointment. To schedule, send email. • Email is appropriate for short questions; longer questions/discussions should be handled in person.

Each team is required to meet for weekly status meetings with their team mentor, with time and place negotiated in first week of semester.

Primary mentoring and problem-solving interactions occur between teams and their assigned CS mentor. The course organizer usually mentors several teams as well, but also has primary responsible for coordinating deliverable schedules and design reviews, as well as working with other CEIAS leaders to organize the Capstone conference.

Course Structure: This course is the second of the two-semester Capstone sequence for the BS in Computer Science program, building on the preparatory CS476 Requirements Engineering course. The structure of this course will be *unlike most other courses that you've taken*. A major objective of the Design Sequence is to wean you from the academic environment, where others schedule your time and efforts, and accustom you to a modern corporate teaming environment, where responsibility for getting things done rests with the team and the individuals in it. We will only occasionally meet as a class for updates and Design Review presentations (mandatory).

Instead, teams will meet with an assigned team mentor (usually a Graduate Teaching Assistant) individually on a weekly basis to review project progress and set goals. Team mentors will take an advisory role on your team as "project coordinator" --- think of them not as the project manager (that role is handled by your team leader), but as the division director to whom you, as a project team, must report regularly. This arrangement allows team mentors to help guide the team and monitor progress, while gaining deeper insight into team performance, dynamics, and effort invested by individuals.

Evaluation Mechanisms: There are numerous mechanisms by which your course grade will be determined, which can be split into three general areas:

Project Work: The bulk of the work in this class will revolve around working as a software consulting team to move your project forward. There are numerous deliverables in the category, including draft and final versions of various documents (software design, final as-built report), several design reviews and, of course, the deliverables associated with the final Capstone Conference. Team deliverables will be assessed for the team, with individual scores adjusted based on peer evals and on team mentor observations.

Class participation: A team (and indeed this class) only works well with the active participation of all participants. The points in this area are assigned by your team mentor, and will be assessed by attendance at meetings and design reviews, peer evaluations, and team mentor observation of team dynamics. Note that this grade is not based so much on your individual technical brilliance, as on how engaged you are with the team and with the process, and how effectively you communicate and collaborate.

Class Outline or Tentative Schedule:

Instruction in this project courses centers around individualized team mentoring, aimed at moving each team through the entire software implementation, testing, and delivery process.

See Online Course Schedule, which includes details on all deliverables specifications, deadlines, and other information:

Grading System:

Weighting of Deliverables:	**Grading Scale**:
The following percentages* are used in weighting total points earned on programming, exams, and participation: • Written deliverables, including final report = 25% • Mid-term alpha demo = 10% • DR presentations = 15% • Capstone Presentation, Poster, and team website = 15% • Product Acceptance demo = 10% • Team Sponsor Evals = 10% • Team mentor eval = 15% *See end of document for specific grading item breakdowns	90-100% = A 80-89% = B 70-79% = C 60-69% = D under 60% = F

Notes:

- Simply completing some minimum viable product is enough to earn a "C". To get an "A" or a "B" you must show additional (i.e. above average or outstanding, respectively) analytic insight, clarity of presentation, and creativity. For more detail on what is expected for each grade level, refer to the ASEE's Guidelines for Engineering Grading and Written Presentation Evaluation Rubric linked on the course website.

- **Peer Evaluations:** Effective teams develop strong internal communication to distribute project load efficiently and effectively. Peer evaluations are an effective mechanism for documenting distribution of team effort and dynamics, and will be filled out for all major phases/deliverables of the semester. The computed outcome is used as a *weighting factor*, applied to the overall team score on presentations and deliverables to arrive at individual grades. In this way, it is quite possible for teammates to get very different grade outcomes, depending on the effort they invested and displayed to their teammates. Thus, just as in the real world, it is critical that you impress your teammates with your reliability and quality!

Class Policies:

Attendance: This course does not meet regularly as a group. Instead, teams have weekly status meetings with their Team Mentor. The time slot for the course is still scheduled and should be blocked out in everyone's schedule. This time block will be used for Design Reviews and other all-hands meetings; attendance at such meetings is *absolutely required.* Capstone has priority: attendance at DRs is required regardless of what else you choose to schedule into the Capstone time block.

Late work and Make-ups: Unless otherwise negotiated with your mentor, all assigned work is due to your mentor by 3pm on the date they are due! The following specific policies apply:

- **Team Deliverables:** In general, late submissions will degrade at a rate of roughly 10% points off per 12 hours late (see current late policy on website for details). For submissions to your team mentor, you may be able to negotiate a shifted due date, depending on the detailed dynamics of you particular project; team mentors have the authority to (slightly) adjust due dates for well-justified reasons arising in individual projects. If you do not receive permission from your mentor *explicitly, in writing,* to shift the due date, the default late policy will apply.

- **Design Reviews and Demos:** These are scheduled tightly and must be presented in the designated time slot. All team members must be present for all presentations, and must participate actively.

Grade Challenges: Although team mentors try their best to grade fairly and all use the same rubrics and/or grading sheets, the notion of "quality" is necessarily subjective at this level. If you feel that your mentor misunderstood some aspect of your deliverable and that more points should have been given, you are encouraged to schedule a meeting with your mentor to discuss the matter. To avoid loss of context, any grade disputes must be brought to a mentor's attention no later than five (5) business days after the assignment was returned.

Deliverable Submission and Format: The entire focus of the CS476/486c sequence is to provide a realistic, professional design/build software engineering experience. Thus, professional comportment is required at all times, and all deliverables should be professionally formatted and presented. This means final documents that are clear, well-organized, and bound in a professional jacket of some sort; drafts may be simply stapled.

Academic Dishonesty: As a professional design course, the notion of academic dishonesty focuses less on "cheating" and shifts more towards ethics and professional dishonesty. In particular, dishonesty regarding your contributions to team efforts, or with respect to your actions as a team member (e.g., lying about attending a meeting, getting work done, etc.) will be considered academic dishonesty and sanctioned as outlined by university policy, and specified below.

- Some examples include violations of patents and copyrights, and not maintaining professional discretion regarding your team's intellectual property or collaborative dynamic.

- Other examples include any artifacts without appropriate attribution, including but not limited to, code from any source, Internet references of any kind, work from your own or others' previous projects, ChatGPT or other AI resources, etc.

A student or team that is found to have exhibited evidence of academic dishonesty will be given a zero on the artifact or product involved, and a notice of academic integrity violation will be provided to the Dean of the College of Engineering, Informatics, and Applied Sciences. **Note that since students at the level of this course will have had extensive experience with, and understanding of the university's academic integrity policies, the most likely recommendation provided in the academic integrity violation form will be for the involved student(s) to be awarded a letter grade of 'F' for the course.**

Individual and Team Failure Policy: Capstone is unlike all other classes in our curriculum in that there is an outside client involved which (just as in real professional practice) means that students and teams have not just a responsibility to themselves and each other, but to their client as well. This means that (a) an individual's failure to contribute their fair share of effort and deliverables effectively can severely affect the progress of the team; and (b) that if a team as a whole becomes non-productive or dysfunctional, there is a danger of wasting the client's valuable time as well as degrading the reputation of our program. Thus, *this course has established policies for terminating both non-performing individual team members, as well as entire projects that become non-viable.* The details of this policy are spelled out in "Policy for non-performing individuals/teams" documents posted on the course website.

Other Important Course Information:

Student success is a joint responsibility. The CS486 course organizer and your individual team mentors are here to facilitate your success, but ultimately this course embodies a semi-independent, realistic consulting experience. This means that, ultimately, is *your responsibility*, as a team, to build a strong team dynamic, assess skills that you have in the team, and manage task distribution and monitoring in some effective and efficient way in order to move the project forward. Just as in the real world, you have the freedom to do as much or as little as you like…with the consequences reflected in the quality of your project outcome and, ultimately, how happy your client is with the outcome. The consequences are "real-world" as well: if you cannot demonstrate that you are ready and able to enter professional practice as a competent software engineer, then the CS program cannot, in good conscience, give you a passing score in this final Capstone course.

Below is a list of what is required to be successful in this particular class:

- **Engage in your project, take ownership.** If you see your project as just one more assignment in a standard class that you have to "keep up with", then you are bound for failure. In the real world, projects are not motivated by some outside force (like your evil professor), but are motivated by your personal drive and professional responsibility. If you don't engage and make this project into a direct representation of what you are capable of as a professional software engineer, then the outcome will be mediocre at best.

- **Recognize that this is your portfolio you are building.** In a standard CS course, you are working to pass the class and get a decent grade. Capstone is different: your capstone project can serve as your professional calling card as you look for your first job; employers often ask candidates about their capstone project. Your project website will be archived and active for many years on the CEFNS website. Make sure it's something you are proud to point people at.

- **Focus on teamwork.** Almost all of you will have had a teaming experience at some time in the previous three years. Whether these went well or poorly, try to learn from them…and apply the experience you gained to get it right. Just as in industry, you will be working with your teammates *for the entire year*. This means that keeping your teammates happy with you should be your absolute priority from day one. Do not let your teammates down; such disappointments can be very hard for them to forget.

- **Give the benefit of the doubt.** Everyone has a bad week sometime, and when this happens to a teammate, it can be easy to immediately form a negative opinion of him/her…especially when you had to personally pick up the slack. Although action should certainly be taken if this becomes a pattern, it is best to initially give benefit of doubt, support your teammate and move on. Maybe next time it will be you that has the hard week.

- **Be direct, but always remain professional.** Emotions like anger, frustration, and disappointment are natural, but have no real place in a team management context. Neither does burying your head in the sand. If you see "issues" developing within your team dynamics, work to address them immediately, with calm, open, factual communication. This management skill is absolutely vital, but can be intimidating to learn. Feel free to come discuss an issue with the facilitator if you'd like advice on how to address it effectively.

- **Practice, practice, practice!** Nobody is an expert at teaming, project management, technical writing, and public presentation from the start. These are the skills that will get you promotions and raises just as much as…and possibly more than…your technical skills. This course and the next one, CS486c, are all about improving and refining these skills…and the way to do that is through practice and feedback on your work. Ask for help if you don't understand why your technical writing is getting poor marks, practice presentations repeatedly until you can speak fluidly and knowledgeably. Nobody enjoys struggling with these things…but you get better by it.

COVID-19 REQUIREMENTS AND INFORMATION

Additional information about the University's response to COVID-19 is available from the **Jacks are Back!** web page located at https://nau.edu/jacks-are-back.

UNIVERSITY SYLLABUS POLICY STATEMENTS

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at https://policy.nau.edu/policy/policy.aspx?num=100601.

COPYRIGHT INFRINGEMENT

All lectures and course materials, including but not limited to exams, quizzes, study outlines, and similar materials are protected by copyright. These materials may not be shared, uploaded, distributed, reproduced, or publicly displayed without the express written permission of NAU. Sharing materials on websites such as Course Hero, Chegg, or related websites is considered copyright infringement subject to United States Copyright Law and a violation of NAU Student Code of Conduct. For additional information on ABOR policies relating to course materials, please refer to ABOR Policy 6-908 A(2)(5).

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224, *Academic Credit*), each unit of credit requires a minimum of 45 hours of work by students, including but not limited to, class time, preparation, homework, and studying. For example, for a 3-credit course a student should expect to work at least 8.5 hours each week in a 16-week session and a minimum of 33 hours per week for a 3-credit course in a 4-week session.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conductive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's *Disruptive Behavior in an Instructional Setting* policy at https://nau.edu/university-policy-library/disruptive-behavior.

NONDISCRIMINATION AND ANTI-HARASSMENT
NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, veteran status and genetic information. Certain consensual amorous or sexual relationships between faculty and students are also prohibited as set forth in the *Consensual Romantic and Sexual Relationships* policy. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's *Nondiscrimination and Anti-Harassment* policy. EAO also assists with religious accommodations. For additional information about nondiscrimination or anti-harassment or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or visit the EAO website at https://nau.edu/equity-and-access.

TITLE IX
Title IX of the Education Amendments of 1972, as amended, protects individuals from discrimination based on sex in any educational program or activity operated by recipients of federal financial assistance. In accordance with Title IX, Northern Arizona University prohibits discrimination based on sex or gender in all its programs or activities. Sex discrimination includes sexual harassment, sexual assault, relationship violence, and stalking. NAU does not discriminate on the basis of sex in the education programs or activities that it operates, including in admission and employment. NAU is committed to providing an environment free from discrimination based on sex or gender and provides a number of supportive measures that assist students, faculty, and staff.

One may direct inquiries concerning the application of Title IX to either or both the Title IX Coordinator or the U.S. Department of Education, Assistant Secretary, Office of Civil Rights. You may contact the Title IX Coordinator in the Office for the Resolution of Sexual Misconduct by phone at 928-523-5434, by fax at 928-523-0640, or by email at titleix@nau.edu. In furtherance of its Title IX obligations, NAU promptly will investigate or equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. The Office for the Resolution of Sexual Misconduct (ORSM): Title IX Institutional Compliance, Prevention & Response addresses matters that fall under the university's Sexual Misconduct policy. Additional important information and related resources, including how to request immediate help or confidential support following an act of sexual violence, is available at https://in.nau.edu/title-ix.

ACCESSIBILITY
Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), ,928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at https://nau.edu/disability-resources/student-eligibility-process or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH
Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at https://nau.edu/research/compliance/research-integrity.

MISCONDUCT IN RESEARCH

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University's Research Integrity Officer, Dr. David Faguy, who can be reached at david.faguy@nau.edu or 928-523-6117. More information about misconduct in research is available at https://nau.edu/university-policy-library/misconduct-in-research.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

Last revised August 4, 2022

SPECIFIC GRADED ITEMS BREAKDOWN
- Students may calculate their interim grades using this reference

Weighting of Deliverables

		ARTIFACT	POINTS	BIASING	WEIGHT
Written	Deliverables	Comm Memo	10	Peer 1	25%
		Design Doc Draft	20		
		Design Doc Final	100		
		Conference Reg	10	Peer 2	
		Testing plan	50	Peer 3	
		Final Report	100	Peer 5	
		Team Reflection	10		
Alpha	Demo				10%
		Alpha Demo	100	Peer 2	
Design	Prsntns	Design Review 2	100	Peer 2	15%
		DR 3	100	Peer 3	
Capstone	Products	Dry Run	20	Peer 4	15%
		Present	100	Peer 4	
		Poster	50	Peer 4	
		Website	50	Peer 4	
		Mini Video	50	Peer 5	
Acptnce	Demo				10%
		Final Demo	100	Peer 5	
Sponsor	Evals	Product Delivery	20	No	10%
				Peer	
		Sponsor Eval	50	Biasing	
Mentor	Eval			No	15%
		Mentor Eval	100	Peer	
				Biasing	

Grading Scale:

A	90% - 100%
B	80% - 89%
C	70% - 79%
D	60% - 69%
F	under 60%